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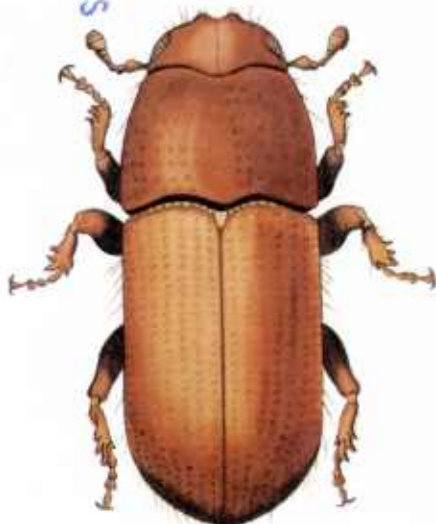
Southern Pine Beetle Handbook

Combined Forest Pest
Research and
Development Program

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An Aerial Observer's Guide to Recognizing and Reporting Southern Pine Beetle Spots

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In 1974 the U.S. Department of Agriculture initiated the Combined Forest Pest Research and Development Program, an inter-agency effort that concentrated on the Douglas-fir tussock moth in the West, on the southern pine beetle in the South, and on the gypsy moth in the Northeast. The work reported in this publication was funded in whole or in part by the Program. This manual is one in a series on the southern pine beetle.

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An Aerial Observer's Guide To Recognizing and Reporting Southern Pine Beetle Spots

**by Ronald F. Billings
and Coleman Doggett ¹**

Introduction

Early detection of new infestations is the first step in controlling the southern pine beetle (SPB) and in reducing timber losses. Over large forested areas, periodic aerial surveys are the most practical observation method. Aerial observers plot suspected beetle spots—pine trees with discolored foliage—onto maps or aerial photographs. Ground crews then check these areas to see if SPB caused the damage and to determine if control is needed. The problem is, during beetle outbreaks, so many suspected SPB spots are reported that ground crews cannot check them promptly. This hampers control operations.

This handbook is designed to help foresters and technicians become efficient aerial observers. It has two sections. First, we describe what SPB spots look like from the air in summer—the season when most new infestations are observed—and explain how to distinguish them from areas with trees dead or dying from other causes. The discussion includes guidelines for assigning a ground check priority to each reported spot. Then, based on seasonal habits of the beetle and on seasonal changes in the appearance of infestations, we describe symptoms that you should look for in fall, winter, and spring.

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Guidelines for Summer Aerial Surveys

Beetle Behavior in Summer



During summer, SPB broods develop rapidly. Within 4-6 weeks after a tree is attacked, the new brood of adult beetles emerges, even though tree foliage may still be green. Because of this delay in foliage fade, many spots may already be “inactive” (abandoned by SPB) before ground check crews can check them. Inactive spots do not require control.

Certain SPB spots, however, expand in summer as adult beetles emerge from brood trees and attack pines at the spot’s edge. Continuous spot growth is most common when beetle populations are high. From the air, the expanding spot appears as a group of red- and yellow-crowned trees (fig. 1), and ground crews checking these spots often find beetles in adjacent green trees. Not all spots expand after detection, but those which do—unless controlled—may cause large timber losses.

Figure 1.— Typical expanding SPB spot in summer.

Recognizing SPB Spots



When new spots first become visible, they may have only light-green or yellow-crowned trees (fig. 2) and not display other stages of foliage fade. This is particularly true in late spring and early summer. But by midsummer the typical expanding SPB spot has dead or dying pines in various stages of discoloration (fig. 1). The different foliage colors trace the beetle's spread through the forest. After 8-12 weeks, beetle-killed trees at the spot's origin drop their needles. Next to these bare

trees are red-crowned ones, most of them no longer containing beetles. Then come yellow-crowned pines that have been more recently killed. Newly attacked trees on the margin of the spot will have green crowns, and from the air you will not be able to distinguish these from unattacked trees.

Figure 2.—New SPB spot with mainly yellow crowns.

Evaluating Potential Spot Expansion

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The major purpose of SPB control programs during the summer months is to reduce timber losses by locating and treating expanding infestations. Spots which are no longer expanding are soon abandoned by the beetles and have little need for control. To assist ground crews, you need to distinguish SPB spots showing visible symptoms of expansion from other spots likely to become inactive.

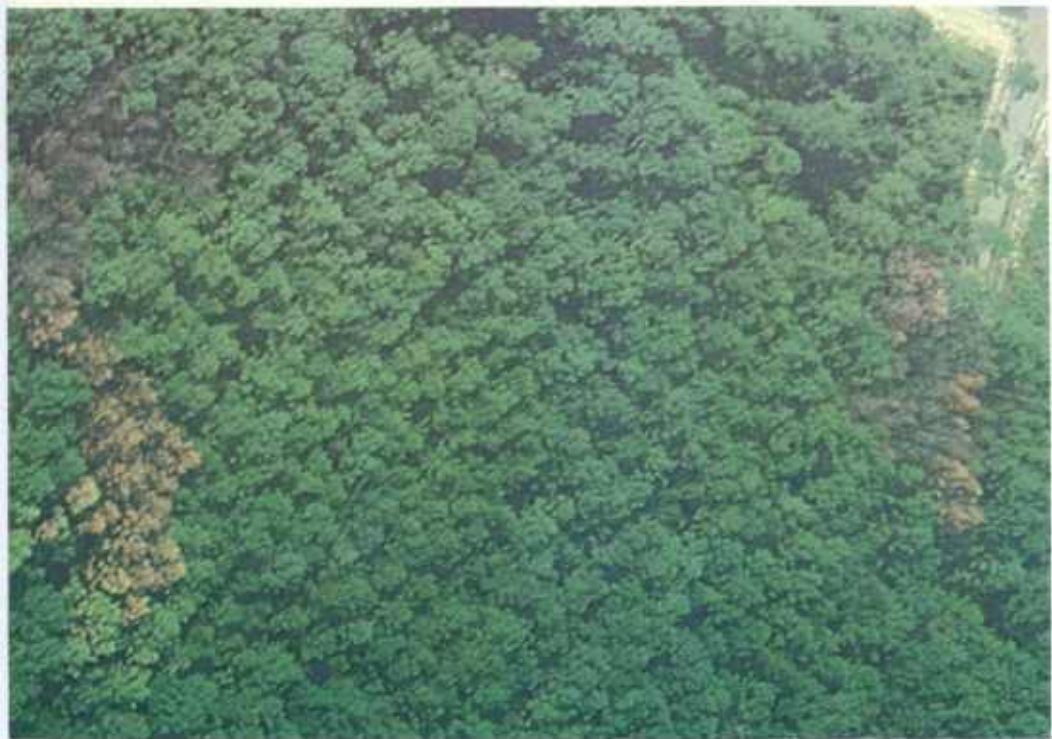
But how can you tell from the air if a spot will expand? Yellow crowns are the most useful clue. An expanding spot will have at least some yellow crowns. Rapidly expanding spots contain as many yellow-crowned trees as red ones. The location of the yellow-crowned trees within the spot marks the path of its spread, which may be in one direction (see fig. 1), or in several (fig. 3). When a spot becomes inactive,

it will no longer have such trees (fig. 4). For control purposes, you do not need to report spots without yellow crowns.

During SPB outbreaks, spots may range in size from one to several hundred trees. As a general rule, the larger a SPB spot appears from the air, the more likely it is to grow. You can greatly aid control operations by reporting only spots with a total of five or more red- and yellow-crowned trees. Spots with fewer than five trees are not likely to expand and will often become inactive during the summer (fig. 5). This minimum will also eliminate recording many small *lps* and black turpentine beetle spots, which are less prone to cause economic losses. True, you may overlook a few expanding SPB spots by using this practice, but these will be recorded later if they exceed five trees in size. During severe beetle outbreaks, forest managers may make the minimum reporting size larger than five trees if workloads of ground check crews become too great.

You should estimate the size of each spot reported. Two methods exist for such estimates: one, recording total number of dead and dying trees, which is indicative of the amount of salvageable timber; or two, noting only the number of red- and yellow-crowned trees, but not those having lost most or all of their foliage. This second method provides a better measure of trees that still contain beetles. Before selecting one method over the other, check the survey policy of your organization. And be sure that ground crews know which estimating system you use.

Figure 3.—SPB spot expanding in several directions.



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Figure 4.—At left, expanding spot; at right, nonexpanding spot.

Figure 5.—Small spot with low beetle activity.

Determining Ground Check Priorities



Figure 6.—High priority spot in plantation (North Carolina Forest Service).

Figure 7.—Low priority spot in sparse pine stand.

If spots are numerous, assign a priority for ground checking to each SPB spot reported. List at the time of observation both the estimate of spot size and the ground check priority next to each spot location on your map or photo. Ground crews will then know which spots to check immediately and which ones they may visit as time permits. For your own reference or to aid new observers, prepare a priority table for your survey area. On it, list conditions to look for in evaluating spots from the air. Table 1 is an example of a priority table for aerial observers.

Experience has shown that SPB infestations in mature sawtimber stands (see fig. 1) or dense pine plantations (fig. 6) are most apt to spread unless controlled. You should assign these spots a higher ground check priority than SPB spots in sparse pine stands (fig. 7) or in areas containing more hardwoods than pines.

Many forest managers prefer commercial salvage of infested pines for beetle control. But the spot must be accessible and have enough timber volume to justify salvage efforts. A logger can afford to build roads when a large volume of timber is involved; a small volume may be worth salvaging only if it is near an existing road. If salvage is the only means of control used in your area, you should give a low ground check priority to small, inaccessible spots.

The land use objective may also influence the priority you assign a spot. A SPB spot in a residential or recreational area (see fig. 3), for example, may require immediate action. But a spot in a wilderness area or in a remote, noncommercial forest may well be given a low ground check priority.

Upon completion of each detection flight, give ground crews a list of the spots requiring ground checking. For each spot, include plotted position, estimate of spot size, and ground check priority. Ground crews then have all the information they need to systematically handle large numbers of spots.

Table 1—*Example of a table for setting ground check priorities from the air, May through October. Choose the spot classification which best describes the spot.*

<i>Priority for ground check</i>	<i>Spot classification</i>
Priority 1 (high)	<p>More yellow- than red-crowned trees</p> <p>In dense natural pine stand or in area with past history of SPB outbreaks</p> <p>Easy access or high salvageable volume</p> <p>In plantation or other high value area</p> <p>Threat to cross property lines and affect high value stands</p>
Priority 2 (breakout)	<p>Yellow-crowned trees in spot previously reported controlled or inactive</p>
Priority 3 (medium)	<p>More red-crowned than yellow-crowned trees</p> <p>Poor access or moderate salvageable volume</p>
Priority 4 (low)	<p>Few yellow-crowned trees</p> <p>Infested pines surrounded by hardwoods or open land</p> <p>Difficult to locate on ground because of small size or inaccessibility</p> <p>In unmerchantable timber or with low salvageable volume</p>

Followup Aerial Surveys

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To aid beetle control programs, you should make periodic aerial surveys every 4-6 weeks. During midsummer surveys, it is helpful to revisit SPB spots recorded on earlier flights but not yet ground checked or controlled. Remember, because of rapid foliage changes in warm weather, the same spot may look different from the air several weeks after detection. Many spots that first appeared active may by

August or September no longer contain yellow-crowned trees. After a followup survey, you may safely assume that such spots have stopped expanding, and give them a low priority for ground checking and control. If all the infested trees in a spot have lost their foliage, the spot can be declared inactive (fig. 8). In winter, however, bare-crowned trees may contain beetle brood and only by ground checking can you verify that SPB spots are inactive.

Some spots that appeared small at first may have grown large by the time of the following flight. If so, you should update their size and ground check priority. For very large infestations,

Figure 8.—An inactive SPB spot.

Updating Flight Maps



To keep current on SPB spots in your area, you must frequently update flight maps. Use the same set of maps or photos for all aerial surveys in a given year. This reduces the chance that a spot will go unreported or be reported more than once. Before each flight, note on your aerial map SPB spots reported by ground crews as inactive or controlled. The notation prepares you for spotting breakouts.

A suggested system for recording spots and updating SPB flight maps is given in table 2. To use this system, draw a small circle around each new spot on your map. Use a different colored pencil for each survey flight. As new information comes in, alter the circle to indicate the current status of each spot.

you can aid ground crews by sketching the infestation boundaries on a map or aerial photograph.

Finally, during midsummer flights, inspect recently controlled spots for signs of renewed beetle activity (breakouts). A breakout appears as a group of red- and yellow-crowned trees at the edge of the controlled area (fig. 9). Report all breakouts.

Figure 9.—Breakout following salvage control.

Distinguishing SPB Spots from Other Tree Problems

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Groups of dead pines with only red crowns are commonly seen during SPB surveys (fig. 10). They may indicate SPB spots that are inactive or no longer expanding. But the red crowns may have been caused by lightning, fire, herbicides, or bark beetles other than the SPB. With close observation, you can learn to recognize damage by these other causes and avoid reporting it as SPB damage.

Figure 10.—Dead pines with only red crowns.

Fire

Foliage Diseases



Trees killed by recent fires appear as red or brown patches, with crowns all the same color (fig. 11). Light fires sometimes scorch trees without killing them, which leaves the lower crown red and the upper crown green. Scorched earth beneath trees and fire-control lines also signal recent fire occurrence.

- 11 Pines suffering from diseases, especially pine “needle cast,” may show symptoms similar to those of SPB-killed trees. Pond pine along the Atlantic Coastal Plain is frequently infected with needle-cast fungi, as are loblolly and slash pines. Common from February through June and again in September and October, needle cast primarily hinders spring and early fall aerial surveys. Moderately affected trees have greener upper crowns than lower crowns. When the spring growth flush begins, green terminal shoots appear on trees with needle cast; no green shoots come out on SPB-killed trees once they turn red.

Figure 11.—Brown patches signaling recent fire.

Herbicides



Uniform strips of yellow- or red-crowned trees along powerlines, pipelines, roads, and railroad tracks (fig. 12) are most often an indication of herbicide application and not of SPB infestations. Sprays applied to agricultural crops often drift onto adjacent stands of trees, causing foliage discoloration. When herbicide damage occurs in mixed pine-hardwood stands, hardwoods are affected along with pines. In timber stand improvement operations, only hardwoods are affected.

Other Bark Beetles



Single, widely scattered yellow- or red-crowned trees observed during summer surveys generally indicate lightning strikes or attacks by bark beetles other than SPB. Black turpentine beetles typically kill single pines. Most *Ips* infestations are small and scattered, often containing only red-topped pines (fig. 13), unlike varicolored SPB spots. *Ips* attacks occur primarily during extended droughts or adjacent to recently logged areas or in storm-damaged stands. In case of large infestations, ground checking is the only way to determine whether *Ips* or SPB is responsible.

Figure 12.—Herbicide-damaged trees along highway right-of-way (North Carolina Forest Service).

Figure 13.—Scattered pines infested by *Ips* beetles.

Checklist for Summer Aerial Surveys

For detecting and reporting SPB spots from May through October, follow these guidelines:

- Decide if the observed trees show symptoms of recent SPB attack. Look for a group of dead and dying pines with at least some yellow crowns.
- For suspected SPB spots, determine if the number of yellow- and red-crowned trees exceeds the minimum reportable size.
- Plot the locations of all reportable spots as accurately as possible on a

map or photo. Use landmarks such as clearings, road intersections, pipelines, and lakes.

- Estimate and record either the total number of affected trees (bare + red + yellow) or the number of recently infested trees (red + yellow).
- Assign a ground check priority to the spot, based on a priority table (table 1). Record this information on the map or photo.
- Report all information promptly to ground check crews.

Table 2.— *Suggested symbols to use on SPB flight maps*

<i>Source of information</i>	<i>Symbol ¹</i>	<i>Description</i>
Initial aerial survey	20/1 ⊙	New spot with 20 trees and priority 1 for ground check (color indicates date of flight)
Ground check information	15/3 ●	Spot found to be inactive upon ground check (use to update flight maps prior to next flight)
Control information	50/1 ⊗	Spot controlled since last flight (use to update flight maps prior to next flight)
Followup flight	20/4 ⊖	Previously seen spot that appears to be inactive from air with bare trees or red crowns or both, but no yellow crowns
Followup flight	100/1 ⊗ B.O./20	Controlled spot that is observed from air to have a breakout with 20 active trees
Followup flight	10/4 ⊙ 100/1	Previously seen spot updated from 10 to 100 active trees and priority 4 to priority 1

¹ Some organizations prefer to use a square symbol □ to indicate that a

spot's location may not be accurately plotted.

Guidelines for Fall, Winter, and Spring Aerial Surveys

Fall Surveys

In the fall, when hardwood leaves change color, it is difficult to detect new SPB spots in mixed pine-hardwood forests. The yellow or red foliage of cypress trees in the fall also may be mistaken for beetle-infested pines. As a result, survey flights are usually discontinued until hardwoods have completely dropped their leaves.



Figure 14.— Winter spots in Virginia (Virginia Division of Forestry).

Figure 15.— Winter SPB spot in Texas.

Winter Surveys

The purpose of winter surveys is to locate overwintering SPB populations so that control can be applied before beetles disperse in the spring. Ground check priorities during winter surveys can be based on just two factors: number of affected trees and accessibility for control. Remember, SPB broods develop more slowly during the winter, often remaining within trees until after the foliage drops. Red crowns in a SPB spot during the winter, unlike those in summer, indicate that beetle broods are present.

The effectiveness of winter surveys for SPB varies among different geographic regions. Their activity restricted by cold temperatures, beetles in the Piedmont and Atlantic Coast States tend to remain throughout the winter in the same multiple-tree spots they occupied during the late fall. These spots become detectable when aerial surveys are resumed in December or January (fig. 14).

In the Gulf Coast, however, beetles in the fall often leave large spots to infest single trees scattered throughout the forest, and, in mild winters, may continue to infest new trees. Pines infested in winter maintain green crowns for 2–4 months, thus escaping observation during aerial surveys. In winter, even multiple-tree spots started in the fall are easy to overlook on the Gulf Coast because the foliage color of infested trees does not change dramatically. Between December and April, infestations seldom show the yellow crowns



that clearly mark SPB spots in summer. At normal survey altitudes (1000–2000 ft), you may be able to see only the larger groups of bare and red-crowned trees (fig. 15). Most of the red-topped pines still contain SPB. But much of the beetle population in winter and early spring occurs in scattered single trees which elude detection. By flying slowly with a helicopter at low altitudes (100–500 ft), you have a better chance of seeing beetle-infested pines in winter along the Gulf Coast. At these low altitudes you may see off-color crowns of beetle-infested pines (fig. 16) that at higher altitudes would not be distinguishable from un-

infested trees. Also, trees killed by SPB often have bark stripped by woodpeckers, which leaves them with highly visible white boles. Although effective, surveys by helicopter are costly and generally applicable only to high value stands.

Figure 16.—Helicopter view of scattered infested pines in winter.

Regional Differences

Spring Surveys

Trees killed by beetles in late winter on the Gulf Coast can be seen during March and April. Even though early emerging beetles may kill large numbers of trees, new spots in spring seldom persist or expand. Temperatures in the spring are still too cool for continuous spot growth. This results in many scattered, short-lived spots in which groups of infested trees show the same foliage color.

Locating new SPB spots in early spring is difficult in mixed pine-hardwood stands: new foliage on hardwood trees makes them resemble SPB-killed pines with fading foliage. As conditions improve for long distance dispersal, however, beetles leave scattered brood trees to concentrate in expanding spots. These multiple-tree spots become easily seen by early summer in the Gulf Coast or by midsummer or later in the remainder of the South.

Because of these seasonal limitations, SPB observation surveys along the Gulf Coast are most effective from May to October. For States along the Atlantic Coast and in the Piedmont region, SPB surveys are practical during midwinter as well as throughout the summer.

The procedures discussed in this handbook were developed primarily from information gathered on the Gulf Coast where SPB may be active throughout the year. Some of the recommendations may require modifications for effective use in other areas of the beetle's range, where there are fewer SPB generations per year and forest conditions are different. If questions arise, check with a Federal or State forest pest control specialist, who can tell you which, if any, of the recommendations are not applicable to your survey area.

Acknowledgment

Guidelines for recognizing and reporting SPB spots during aerial surveys are derived from research and operational experience of the Texas Forest Service and the North Carolina Division of Forest Resources. The authors gratefully acknowledge the contributions provided by other State and Federal forest pest control specialists throughout the South in the preparation of this handbook. The photographs were provided by the Forest Pest Control Section of the Texas Forest Service, unless otherwise noted.

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